Wilson Bull., 95(4), 1983, pp. 621–627

VARIATION AND MIGRATION OVERLAP IN FLIGHT FEATHER MOLT OF THE ROSE-BREASTED GROSBEAK

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Variation in body plumage of Rose-breasted Grosbeaks (*Pheucticus ludovicianus*) has been frequently noted (e.g., Stone 1899, Bagg and Eliot 1937, Whittles 1938, Smith 1966). Variability of flight feather pattern and molt has, to our knowledge, been addressed only twice. Oberholser (1974: 97), incorrectly, and Dwight (1900:97) each commented on the variability of the first prealternate tail molt. In this paper we document variation in the molt and pattern of flight feathers of male Rose-breasted Grosbeaks. We present five cases of arrested wing molt, amplify Dwight's (1900) comments on tail molt, and show that this species differs from the majority of migratory birds by initiating autumn migration while flight feather molt is still underway.

METHODS

We used mist-netted birds and museum specimens to assess the molts and plumages of male Rose-breasted Grosbeaks. Females were omitted from the study for practical reasons: it is difficult to detect feathers of differing ages among their uniformly brown flight feathers.

The mist-netted birds were primarily from Kent Island, New Brunswick, where Cannell and Cherry operated a banding station from July to mid-October 1980. Specimens at the following museums were examined: American Museum of Natural History (AMNH), Carnegie Museum of Natural History (CM), Museum of Comparative Zoology (MCZ), Field Museum of Natural History (FM), New York State Museum (NYSM), and the Buffalo Museum of Science (BMS). Included were collections salvaged from television transmission towers, providing data on birds known to be migrating at the time of death. Specimens salvaged from the towers of WFMJ (Youngstown, Mahoning Co., Ohio), WIIC (Pittsburgh, Allegheny Co., Pennsylvania), and WKZO (Gun Lake, Barry Co., Michigan) are at the CM. Birds salvaged from the towers of WGR and WKBW (Buffalo, Erie Co., New York) are at the BMS.

All birds, live and preserved, were examined for molt in a manner similar to that prescribed by Snow (1967). Molt of body plumage was classified as slight, medium, or extensive. Birds molting flight feathers received a score for each flight feather according to the age or stage of growth of that feather.

RESULTS AND DISCUSSION

Arrested molt.—On 28 September 1980, at Kent Island, New Brunswick, Cannell and Cherry mist-netted a second-year male Rose-breasted Grosbeak with symmetrically arrested wing molt. The primaries, tertials, all coverts, and the first (distal) two secondaries were typical black definitive basic (adult) feathers. The third, fourth, fifth and sixth secondaries on

each wing were retained juvenal feathers, brown and worn. There was no active body or flight feather molt. Apparently the molt sequence had been discontinued at this stage, not to be resumed, qualifying as arrested molt, in the sense of King (1972). This last grosbeak of a field season that extended through 13 October was banded, photographed, and released.

A second case of arrested wing molt was found at the MCZ. A second-year male (MCZ 297059) collected on 20 August 1874 at Upton, Oxford Co., Maine, had retained the sixth juvenal secondary on the right wing.

Three additional cases of arrested molt were found among Buffalo tower killed birds. These were after-second-year birds retaining definitive remiges from the previous year's plumages. Although both of these feather generations are black, the retained remiges show a clear shade contrast with the new remiges, and their terminal white spots are worn away. These birds were salvaged on 21 September 1977 (BMS 7562), 24 September 1970 (uncatalogued), and 29 September 1982 (BMS 7561). None were in active molt, except for the 1982 bird, which had nearly full grown outer primaries. These specimens had retained, respectively, secondaries 4–6, 3–6, and 3–6.

Arrested and omissive prealternate tail molt.—Oberholser (1974:858) incorrectly stated that the tail acquired by the "partial prenuptial" (=first prealternate) molt of first-year males is "entirely or in part brown like that of females." Unlike most birds, Rose-breasted Grosbeaks do renew their tail in the first prealternate molt, but the color of the new generation of rectrices is black. Oberholser may have observed a phenomenon which Dwight (1900:97) understood and described more accurately: this first renewal of tail feathers may be incomplete, with one or more brown juvenal rectrices being retained.

We examined museum specimens to determine the nature and extent of the incomplete spring tail molt mentioned by Dwight (1900). We found it to be surprisingly common. Of 46 males in first alternate plumage in the AMNH, 17 (37%) showed incomplete molt of the tail. Of 22 males in first alternate plumage in the CM, 11 (50%) had failed to molt some rectrices. Of 22 first alternate plumage males in the FM, 15 (61%) showed incomplete tail molt. Comparable frequencies of incomplete tail molt were found among specimens in the MCZ and the NYSM. None of these birds showed active tail molt.

The replacement of rectrices in these birds shows two patterns. In some specimens, replacement is basically symmetrical and sequential, usually with only the central pair, or central two pairs of rectrices having been replaced. Exceptionally (FM 311878) as many as five right and four left rectrices are black adult-type rectrices. These represent cases of arrested molt, in which molt of the feather tract has ceased prior to completion. In

TABLE 1
EXAMPLES OF OMISSIVE FIRST ALTERNATE ROSE-BREASTED GROSBEAK RECTRICES

Mus. no.	State/Province	Date	Rectrix pattern	
			Left	Right
AMNH 513966	Ontario	10 May 1889	AAAAAA	AJJAAA*
AMNH 56646	Ohio	8 May 1870	AAAAJA	AAAAAA
AMNH 53098	Minnesota	13 May 1889	JJJJAA	AJJJJA
AMNH 65920	New York	4 May 1888	JAAAAA	AAAAJA
AMNH 68365	New York	11 May 1890	AAAAAJ	AAAAAA
AMNH 229771	New York	26 May 1908	AJJJJJ	JJJJJJ
AMNH 364719	New York	17 May 1890	AJJJJA	AJJJJJ
CM 149687	Pennsylvania	17 May 1973	AAJJJA	AJJJJA
CM 151731	Ontario	? May 1900	JJJJJA	AJJJAJ

* J = juvenal rectrix; A = adult rectrix.

other specimens, the location of retained juvenal rectrices is irregular and asymmetrical (Table 1). In these, molt apparently continues to conclusion along the tract, but skipping one or more feathers along the way. We call this phenomenon "omissive molt."

Dwight (1900) suggested that the prealternate tail molt takes place in "late winter." This statement is supported and refined by a number of second-year museum specimens with tail feathers in sheath. Two March specimens from Colombia, AMNH 122691 and CM 41722, indicate symmetrical, and sequential tail molt. CM 28091, taken 10 March in Costa Rica, had already completed its entire tail molt and was just completing its body molt. FM 220605, taken in Colombia on 28 February 1950, had just dropped its central rectrices.

Another Colombian specimen (CM 58814), taken 30 November, had replaced the central pair of rectrices (one with traces of sheathing at the base) but was also growing the three outermost right rectrices. That this was not replacement of accidentally lost feathers is indicated by the fact that body molt was also being initiated in a number of tracts on the specimen, and that the three right outer rectrices (R) were growing in normal sequence, not simultaneously (R4 almost full length; R5 about 10 mm; R6 just showing). This specimen would appear to document a case of omissive molt occurring during the first prealternate molt, which therefore may take place early as well as late in the winter.

Prealternate flight feather molt in Rose-breasted Grosbeaks is thought to be restricted to the tails of young birds, entering their first alternate plumage (Dwight 1900). An adult (black-plumaged) male (FM 15799) taken

on 26 March 1904 in Nicaragua showing symmetrical molt of both rectrices and remiges is therefore surprising. It was growing its right and left seventh primaries, and its two left central and three right central rectrices.

Plumage color irregularities.—Dwight (1900) also commented, in regard to the first prealternate tail, that the color might be "deficient." Color deficiency in these rectrices seems to take the form of feathers that shade from solid black to brown, usually within the last centimeter of the tip of the feather. Several skins (e.g., AMNH 364686, 364936; CM 64632) show this tendency.

An adult male (CM 151738) taken in Taunton, Bristol Co., Massachusetts, on 12 May 1916 has a left central rectrix conspicuously browner than the rest. It is no more worn than the other rectrices, so cannot have been retained from a previous plumage. This single brown rectrix may be attributable to a defect in the feather follicle itself, as feathers growing from injured areas in birds are sometimes deficient in pigment (K. Parkes, pers. obs.).

A color variability not mentioned by Dwight (1900) is the tendency toward definitive black coloration in normally brown juvenal remiges (e.g., AMNH 364696, 513969, 53097, and CM flat skin T–164). Such wings show large (up to 25 mm) areas of black on the outer primaries, fading distally to the brown of typical juvenal remiges. The typical "white area at the base of the primaries" described by Dwight (1900:208) for the juvenal plumage may be enlarged to as much as 15 mm, approximating the definitive adult condition. A possibly related observation was made by Cannell, who mist-netted a female Rose-breasted Grosbeak on 17 May 1982 at Fire Island, Suffolk Co., New York, which had one black male-type rectrix (left central) among normal brown female rectrices.

Clearly, the molts and plumages of male Rose-breasted Grosbeaks are more variable than those of other passerine species, at least as these are currently described. The degree of variability in females, in which differences between age classes are inconspicuous and molt irregularities are not so easily noticed, has not been fully studied. Although Dwight (1900) suggested that the prealternate molt of females is limited or non-existent, differing degrees of rectrix wear among spring female specimens from the United States suggests the possibility of an incomplete prealternate tail molt like that of males.

Molt in migrating birds.—A third aspect of the molt of Rose-breasted Grosbeaks, in addition to sequence and coloration, also appears to be unusual. As a rule, migratory species in the temperate zone show little overlap between molt and migration. In most cases migration does not begin, or progress very far, until completion of flight feather molt. Certain species may delay the entire molt until after arrival on the wintering

grounds. Still other species may begin the molt, suspend it for the duration of the migratory journey, and resume it after arrival on the wintering grounds (e.g., certain Sterninae, Columbidae, Nectarinidae, etc.; Snow 1967). This is the "interrupted molt" of Payne (1972) and the "suspended molt" of Prater et al. (1977). In the words of Payne (1972:139), "the temporal separation of molt, breeding, and migration in the annual cycle is often interpreted as an adaptation that minimizes the day-to-day strain on the energy resources of a bird." Unfortunately, subsequent discussion of this topic, by Payne and others, is confined to the energetic relationships of molt and breeding, not molt and migration.

One of the difficulties in addressing the latter topic is the paucity of information on the molt of birds that are actually migrating. The disappearance of birds from a breeding population under study does not necessarily mean initiation of migration. Nor are birds collected at localities intermediate to the breeding and wintering grounds and shown to be undergoing active molt necessarily migrating. In both cases an unknown period of resting, feeding, and local wandering may be occurring. It is nevertheless interesting, in light of information presented below, that two of four adult Rose-breasted Grosbeaks mist-netted at Kent Island, New Brunswick, by Cannell and Cherry during autumn 1980, were molting flight feathers. A third showed arrested molt, as described above.

Birds killed at night by striking some obstacle provide a unique record of birds actually in the process of migrating, but of numerous papers on tower killed birds few report in detail on the status of molt in salvaged specimens. Tordoff and Mengel (1956) comment on molt in tower-killed birds and mention the Rose-breasted Grosbeak as a species that "evidently migrates at times in extensive molt." Two specimens are mentioned: an immature in heavy body molt and an adult male in both body molt and heavy flight feather molt.

We examined specimens salvaged from five television transmission towers, described above. These samples included over 4000 autumn-killed passerine birds, including 57 adult male and female Rose-breasted Grosbeaks. Of these, 52 (91%) showed active wing molt, usually including both primaries and secondaries. Five specimens show active tail molt. Most of these, as well as all specimens of immature Rose-breasted Grosbeaks, also show body molt. Of the specimens showing wing molt, 33 have either only the outermost (P9) or only the two outermost (P8, P9) pairs of primaries sheathed at the base. Only three specimens show primaries other than these in molt. One of these (CM 150648) has P2 and P3 about ¾ grown on the right wing, but completed on the left. The other two have P7 more than half grown. In the 16 specimens that were not molting primaries, a varying number of secondaries were growing. The most ex-

treme example, a female (CM 150651), has left S2 growing, with S3 and S4 not yet shed; on the right wing, S3 is growing, and S4, S5, and S6 are not yet shed.

One of the Michigan wings (CM T–3676) apparently shows an omissive molt pattern. In this specimen, P9 and S4 are not yet full grown, S5 is a retained worn juvenal feather, and S6 and all other remiges are new. It is impossible to know whether S5 might have been renewed later, out of sequence, or retained until the next complete prebasic molt the following autumn. In the latter case, the molt would be classified as omissive.

Although it is impossible to know the source of the grosbeaks that struck the TV towers, it is clear that in at least part of its range this species initiates its autumn migration well before completion of the prebasic molt. Some birds that hit the towers would have been growing feathers for several days thereafter, at the least.

An examination of the rest of the large samples confirms that overlap of molt and migration is exceptional. Most of the species represented were vireos and wood warblers with lesser numbers of Gray Catbirds (*Dumatella carolinensis*) and thrushes (*Hylocichla mustelina* and *Catharus* spp.). Most of these showed no molt whatsoever. Only the Red-eyed Vireo (*Vireo olivaceus*) showed a high proportion of adult birds with flight feather molt (8 of 26 examined). Further details of these samples will be presented in another paper.

SUMMARY

Rose-breasted Grosbeaks (*Pheucticus ludovicianus*) are extremely variable in several aspects of their flight feather molt. They have a high frequency of arrested molt of the remiges. They commonly show arrested and "omissive" molt in the prealternate rectrix molt of the first-year males, of which as many as half may replace only part of the tail. The coloring of adult and juvenal feathers shows great variability. Finally, most Rose-breasted Grosbeaks that strike TV towers during their nocturnal migration in the autumn are still molting flight feathers. No other species studied thus far shows such a prevalence of active molt during migration.

The reasons for variability in molt and plumage are unknown, as are the reasons for an apparent relative lack of variability in the molt and plumage of other species. We hope that this paper will prompt further investigation of molt variation, and of overlap between molt and migration, in Rose-breasted Grosbeaks and other species.

ACKNOWLEDGMENTS

We thank J. Barlow, J. Farrand, Jr., C. Huntington, W. Lanyon, R. Payne, and an anonymous reviewer for comments on drafts of this manuscript. We thank the curators of the Field Museum of Natural History, the Museum of Comparative Zoology, and the New York State Museum for access to their skin collections. A. Clark, of the Buffalo Museum of Science, kindly allowed study of the numerous specimens he has salvaged from WGR and WKBW. The Carnegie Museum of Natural History is indebted to the late W. A. Bartolo of

Youngstown, Ohio, for organizing the salvage projects at WFMJ; to several individuals, including J. Matviya and R. Mulvihill, for salvaging specimens at WHC, and to C. Fichtel for his meticulous documentation of molt, cranial, and other data during his preparation of hundreds of specimens. R. Adams of the Kalamazoo (Michigan) Nature Center kindly donated the specimens salvaged at WKZO. This is contribution number 52 of the Kent Island Scientific Station, Kent Island, New Brunswick.

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ORNITHOLOGY DEPT., AMERICAN MUSEUM OF NATURAL HISTORY, 79TH STREET AND CENTRAL PARK WEST, NEW YORK, NEW YORK 10024; DEPT. BIOLOGICAL SCIENCES, STATE UNIV. NEW YORK, ALBANY, NEW YORK 12222; AND CARNEGIE MUSEUM OF NATURAL HISTORY, 4400 FORBES AVENUE, PITTSBURGH, PENNSYLVANIA 15213. ACCEPTED 25 APR. 1983.